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DOI:

[10.1002/esp.4129](https://doi.org/10.1002/esp.4129)

Document Version

Peer reviewed version

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Citation for published version (APA):

Clarke, L., Schillereff, D., & Shuttleworth, E. (2017). Communicating geomorphology: An empirical evaluation of the discipline's impact and visibility. *EARTH SURFACE PROCESSES AND LANDFORMS*, 42(7), 1148–1152 .
<https://doi.org/10.1002/esp.4129>

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**Communicating geomorphology: an empirical evaluation of the discipline's
impact and visibility**

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Abstract:

Concern amongst geomorphologists that the discipline's visibility and impact are
becoming suppressed are reflected in a series of recent Earth Surface Exchanges
(ESEX) commentaries (e.g., Tooth *et al.*, 2016). This paper from the British Society for
Geomorphology (BSG) Communicating Geomorphology Fixed-Term Working Group
(FTWG) reports initial findings from an online survey of BSG members alongside an
empirical assessment of the term's prominence in academic output: international peer-
reviewed journals, undergraduate Geoscience degrees in world-leading institutions and
the UK Research Excellence Framework (REF) impact statements. Our observations

indicate the scientific standing of the discipline has been retained but the term itself is less widely utilised and we offer a series of suggestions actionable by the geomorphology community.

Keywords: communication, geomorphology, perception, impact, academia

1. Introduction

Geomorphology underpins many pressing environmental issues, such as extreme events (Naylor *et al.*, 2016). There is a growing recognition that successful management strategies require effective dialogue between researchers and stakeholders (Fogg-Rogers *et al.*, 2015), and understanding how best to communicate scientific research is a growing area of study (e.g. Bogaard *et al.*, 2015; Illingworth and Allen, 2016). There have also been calls recently for physical scientists to refocus the purpose of communicating outside of the academy (Lane, 2016); to reflect upon why we are doing it and for whom. However, to date there has been limited assessment of how to best communicate the concept of geomorphology, and concerns persist around the visibility of geomorphology (Brierley, 2009; Gregory *et al.*, 2014; Gregory and Lewin, 2015; Tooth *et al.*, 2016), declining usage of the term in academic literature (Woodward, 2015), the language used (Lewin, 2017) and public awareness of the discipline's scientific scope (Tooth, 2009). The term does not appear in the UK National Flood Resilience Review (HM Government, 2016), the UK's revised GCSE and A-level curricula content reports contain the term twice (Department for Education, 2014a) and once (Department for Education, 2014b) respectively, despite the inclusion of prominent

geomorphological concepts. Its absence from media coverage of geomorphological hazards is also notable; a keyword search of a selection of UK broadsheet online reporting on the winter 2015/16 Cumbrian floods returned zero results.

The geomorphological community within academia are mindful of these issues (Gregory *et al.*, 2014) and measures are beginning to be taken to address them, including publication of a [10 Reasons Why Geomorphology is Important](#) booklet and establishment of the British Society for Geomorphology's (BSG) Fixed-Term Working Group (FTWG) on *Visualising Geomorphology* (Tooth *et al.*, 2016). However, there has been little evaluation of how geomorphology is perceived from outside of the academy. Better understanding how a wider audience 'see' geomorphology and its relevance is crucial to develop tailored communication strategies and maximise the impact of geomorphological research.

In 2015, the BSG funded a FTWG on *Communicating Geomorphology* to perform such an evaluation, and this paper reports its initial findings. These comprise observations from a survey of UK and non-UK-based BSG members and an assessment of the term's prominence in key academic output: (1) peer-reviewed journals, (2) undergraduate degrees, and (3) the UK Research Excellence Framework (REF) impact statements. Our findings are focussed on the UK, where research funds are allocated based on the REF initiative, but they are also relevant globally; a similar assessment system has been trialled in Australia (Morgan Jones *et al.*, 2013) and many other

countries operate alternative impact assessments (Key Perspectives Ltd, 2009; Wright *et al.*, 2014, Jonkers and Zacharewicz, 2016).

2. Views on communicating geomorphology from the BSG membership

In 2015 we canvassed the views of the BSG membership through an online survey; 137 responses were received (31% of society membership). The survey aimed to determine if and how members actively communicate or have communicated geomorphology, the audiences with whom they have engaged and where they believe the discipline is being effectively communicated. Respondents represented all academic career stages (from PhD to Professor, plus a Vice-Chancellor), and included twelve non-academic positions, including industrial practitioners, policy advisors and teachers. Most respondents were UK based but we also received contributions from Italy, India and Canada.

The vast majority (85%) of respondents include the term 'geomorphology' in online profiles, with a heavier presence (65%) on academic-facing sites such as ResearchGate and Academia.edu compared to more public-orientated platforms such as personal webpages, blogs or Twitter (15-42%). While in part, this reflects respondents not engaging with these latter media, it does question whether persistent visual appearance of the term would enhance public awareness.

The wide breadth of geomorphological research is emphasised by the range of disciplines to which respondents also associate themselves (Figure 1). *Geology*, *Geography*, *Quaternary* and *Environmental* appear most frequently, although 26

92 separate disciplines were recorded at least twice and 22 more appeared once
93 (respondents could choose as many disciplines as they wished.) Interestingly, 'geology'
94 was most common despite the majority of respondents being employed in geography
95 departments. That geomorphology is strongly co-disciplinary was highlighted as both a
96 positive (diversity) and negative (dilution) characteristic in the follow-up focus groups;
97 determining how geomorphologists best exploit this feature is clearly important. Many of
98 these disciplines have Learned Societies and professional networks so fostering closer
99 links could be a fruitful path for geomorphologists.

100
101 When asked about the importance of geomorphology and how it is received by groups
102 outside of academia an interesting geographical division was noted. In the UK, the
103 general feeling was that the term was not synonymous with environmental hazards and
104 media portrayal of these. However, respondents from Canada and Italy suggested that
105 the difference of perception was related to the scale of hazard/landscape. Flooding
106 anywhere in the world can be devastating, but the absence of natural (i.e., perceived to
107 be unaffected by human disturbance) landscapes in the UK mean that
108 geomorphologists are not the first point of contact, as opposed to countries such as
109 Canada or Italy where understanding wild landscapes is more likely to be at the
110 forefront of public knowledge.

111
112 To identify established pathways of geomorphological communication, we classified six
113 audiences: academia, schools, public events, press and media, policy makers and
114 industry. The numbers of BSG members who indicated engagement with one or more is

presented in Figure 2. Affirmative responses were invited to provide examples. Widespread personal engagement with outreach, especially with schools and at public events (nearly 50%), is evident. Examples of the former include careers talks, classroom and field-based teaching, Learned Society events and some involvement with curriculum development. Respondents listed public talks at various shows, fairs and conferences, guided nature walks and cycling excursions. Only two instances of discussions with local residents at field sites were highlighted. While some respondents may not have considered this public engagement, it is surprisingly low and a potential avenue for future efforts.

Between 30 and 40% of respondents had communicated to policy makers, industry representatives or elements of the media. Most press engagements occurred in response to an extreme event or focused on unusual topics, such as Martian geomorphology or remote sensing of archaeological looting. Seven had participated in documentary production but the term 'geomorphology' tended to be removed during programme editing. Individual survey responses suggest selected BSG members have fostered long-standing relationships with press contacts and are regularly sought for comment, whereas new/casual engagement is rarer. One member responded to a news outlet's call for expert comment on Twitter, indicating that social media could be exploited to enhance media exposure to geomorphology.

Engagement with industry and policy-makers is a stated outcome for many large Research Council grants in the UK, and Table 1 reinforces the breadth of expertise

sought for industrial advice; open-ended responses indicate few but select respondents are repeatedly called on. Only one BSG member highlighted their participation on the [Royal Society Pairing Scheme](#) (policy) and a [Royal Society Industry Fellowship](#); these may be routes that geomorphologists should look to exploit more frequently.

INSERT TABLE 1

In summary, there is demonstrable evidence of strong public-facing engagement amongst the respondents, in addition to the initiatives of the BSG Outreach Subcommittee. A comparison of the level of engagement with other Learned Societies is an avenue the Communicating Geomorphology FTWG intend to pursue.

3. Does geomorphology create impact?

There is increasing emphasis on demonstrating the impact of research, to show ‘value for money’ from funding (Fogg-Rogers *et al.*, 2015). UK Higher Education funding bodies have adopted this by including *research impact* as one of the assessment criteria for REF, i.e. how research affects, changes or benefits the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia (HEFCE, 2014). To determine the impact of geomorphology in UK science, the impact case studies submitted to the Geography, Environmental Studies and Archaeology (Unit 17) group in REF2014 were analysed. Out of the 85 impact cases, 17 (20%) mention geomorphology directly, and 40 (47%) are inherently geomorphological even though term is not explicitly mentioned. Such a large proportion involving

geomorphology clearly demonstrates its importance to UK research and beyond, and confirms the relevance of the discipline outside of the academy. The onus is on authors of future impact case studies to make the term more visible.

4. Geomorphology in academic journals

To evaluate the prevalence of the term 'geomorphology' in academic research the top 50 journals that geomorphologists submit to were analysed to find whether the term was listed as a keyword and/or present in the journal description (Table 2). This follows on from Gregory *et al.* (2014, Table 3) who evaluated the foundation dates of the journals that they considered to be key geomorphological outputs to determine whether the term was being used by these publications. 21 out of the 50 (42%) journals that were looked at explicitly used the word geomorphology in their description, and 14 (28%) use it in their journal keywords. Of the journals that did not use the term, related phrases such as *earth systems science* and *processes that affect the form and function on the Earth* were stated as part of the journal homepage, and so would still appeal to the geomorphology community. It is worth noting that some of the higher impact general science journals (e.g. Nature, Science) do not list any discipline-specific terms on their website.

INSERT TABLE 2

5. Geomorphology in undergraduate teaching

To continue to maintain the term geomorphology it is important that future generations of undergraduates are exposed to the discipline during their degrees. To determine the presence of geomorphology in undergraduate degrees, module titles and descriptions for Geography degrees in UK, Singapore, Switzerland and the USA (the four countries with institutions ranked in the top 20 of the QS World University Rankings, 2016) were analysed. This method does not capture those modules that include geomorphology as part of a module but have not named it in the descriptor, but it gives a good indication of its occurrence in university curricula.

In the UK, 79 Geography degrees are run at 72 institutions; 46% offer a geomorphology module. The majority are Level 5 (2nd year) modules, either named 'geomorphology' (n=28) or an optional specialism, such as aeolian geomorphology, glacial geomorphology, or hydrogeomorphology (n=17). The two universities in Singapore ranked in the QS Top 20, both offer Geography degrees. The degree programme at National University of Singapore offers multiple modules titled geomorphology, while the School of the Environment: Nanyang Technical University did not mention the term but ran geomorphology related modules. Of 12 universities in Switzerland, four offer a module titled geomorphology at institutions who offer a Bachelor's programme in Physical Geography or a Geoscience degree. Of the US institutions ranked in the Top 100 of the QS Table (n=32), those with a Department of Geography (n=9) tended to run a module entitled 'geomorphology' (78%). Conversely, where geoscience Majors are taught in Earth, Ocean or Environmental Science administrative units (n=22), less than half (45%) delivered a named 'geomorphology' course.

206

207 Fostering the future of geomorphology means teaching it. While it is clearly a strong
208 component of geoscience teaching at undergraduate level but is often merged into
209 broader themes, especially Earth System Science. In principle, this need not be cause
210 for concern as scientific impact increasingly hinges on this paradigm (Rockström, 2016),
211 but there is scope to improve how non-geographers utilise and teach geomorphology.
212 We advocate more explicit use of the term in Higher Education teaching to maximise its
213 exposure to the next generation of scientists and increase the likelihood that they will
214 engage with the discipline and classify themselves as geomorphologists in the future.

215

216 **6. Moving forwards**

217 We have found that geomorphology maintains a strong scientific standing, highlighted
218 by the presence of geomorphological content in journal descriptions, undergraduate
219 courses, and UK REF2014 impact case studies. The term itself, however, does not hold
220 equal prominence and the geomorphological message and content may be implicit
221 rather than explicit. This suggests that a responsibility lies with us, as geomorphologists,
222 to raise the term's profile when engaging with the public, media, policy makers and/or
223 students. This will require different approaches for different audiences. Part of this
224 FTWG's on-going remit is crafting nuanced messages for each audience. We are in the
225 process of engaging with those outside of geomorphology to find out what they would
226 like us to offer, and how best we can pitch our work to them. We are very interested in
227 garnering the views of geomorphologists from outside of the BSG membership and

worldwide. We believe only through proactive discussion and analysis will we be better placed to understand the contribution of geomorphology to society.

Acknowledgements

We are grateful to the BSG for funding the FTWG and sincere thanks to all BSG members who completed the online survey, emailed with additional comments, and/or participated in the Focus Groups for sharing your views. Thanks also to Dr Brian Payne (University of Gloucestershire) who reviewed the initial survey, Professor Martin Evans (University of Manchester) for comments on an earlier draft, and Professor Stuart Lane for his insightful comments during the review process.

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Figure captions

Figure 1. WordCloud of scientific disciplines to which respondents associated themselves in addition to geomorphology, filtered to words with a frequency of 2 or more. The generic words *science*, *geoscience* and *research* have also been removed for visual clarity.

Figure 2. Number of survey respondents (%) who have previously engaged in the communication of geomorphology to pre-determined audiences.

Table 1. In addition to *environmental consultancy*, survey respondents indicated they had been sought to advise the following areas of industry.

Coastal management	Oil industry
Technological development	Nuclear waste burial
Conservation	Engineering
Mineral exploration/aggregates	Water suppliers
River restoration	Knowledge exchange

Table 2. Journals that do/do not mention geomorphology in their keywords or journal descriptions

Mention geomorphology	Do not mention geomorphology
Aeolian Research, Catena, Earth & Planetary Science Letters, Earth Surface Dynamics, Earth Surface Processes & Landforms, Ecohydrology,	Agricultural Water Management, Annals of Glaciology, Annals of the Association of American Geographers, Biogeosciences, Canadian Geographer,

<p>Geoarchaeology, Geografiska Annaler: Series A, Geography Compass, Geomorphology, Geophysical Research Letters, Journal of Arid Environments, Journal of Geology, Journal of Geology & Geophysics, Journal of Hydrology, Land Degradation & Development, Nature Geoscience, Permafrost & Periglacial Processes, Progress in Physical Geography, Quaternary Research, Solid Earth</p> <p>N = 21</p>	<p>Cryosphere, Earth-Science Reviews, Environmental Earth Sciences, Geographical Journal, Geographical Research, Geology, Holocene, Hydrology & Earth System Sciences, Journal of Geographical Systems, Journal of Geophysical Research: Earth Surface, Journal of Glaciology, Journal of Paleolimnology, Journal of Soils & Sediments, Landscape Ecology, Marine Geology, Nature, Paleogeography, Palaeoclimatology, Palaeoecology, Quaternary International, Science, Science of the Total Environment, Sedimentology, Soil & Tillage Research, Transactions of the Institute of British Geographers, Water Resources Research</p> <p>N = 29</p>
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